4. **Access road gates** shall be 16 feet in width consisting of two swinging sections 8 feet in width. Additional vehicular access gates may be required as needed to facilitate maintenance access.
5. **Pedestrian access gates** (if needed) shall be 4 feet in width.
6. For fences to be maintained by the County, **fence material** shall be vertical metal balusters or 9 gauge galvanized steel fabric with bonded vinyl coating. For steel fabric fences, the following apply:
   a) **Vinyl coating** shall be compatible with the surrounding environment (e.g., green in open, grassy areas and black or brown in wooded areas). All posts, cross bars, and gates shall be painted or coated the same color as the vinyl clad fence fabric.
   b) **Fence posts and rails** shall conform to WSDOT Standard Plan L-2 for Types 1, 3, or 4 chain link fence.
7. For **metal baluster fences**, Uniform Building Code standards shall apply.
8. **Wood fences are allowed** in subdivisions where the fence will be maintained by homeowners associations or adjacent lot owners. Fence maintenance requirements shall be a condition of subdivision approval, and a statement detailing maintenance responsibilities and requirements must be recorded with the plat.
9. Wood fences shall have **pressure treated posts** (ground contact rated) either set in 24-inch deep concrete footings or attached to footings by galvanized brackets. Rails and fence boards shall be cedar or pressure-treated fir or hemlock.
10. Where only **short stretches of the pond perimeter** (< 10%) have side slopes steeper than 3:1, split rail fences (3-foot minimum height) or densely planted thorned hedges (e.g., barberry, holly, etc.) may be used in place of a standard fence.

Signage

Detention ponds, infiltration ponds, wetponds, and combined ponds to be maintained by King County shall have a sign placed for maximum visibility from adjacent streets, sidewalks, and paths. The sign shall meet the design and installation requirements illustrated in Figure 5.3.1.D (p. 5-29).

Right-of-Way

1. Open detention ponds shall not be located in dedicated public road right-of-way.
2. Detention ponds to be maintained by King County shall be in a tract dedicated to King County (see Section 1.2.6). Any tract not abutting public right-of-way will require a 15-foot wide extension of the tract to an acceptable access location.

Setbacks

1. A setback of 5 feet from the **toe of the exterior slope**, retaining walls and rockeries to the tract or property line is required for County-maintained ponds and recommended for privately maintained ponds.
2. The tract or property line on a detention pond cut slope shall be setback 5 feet from the **emergency overflow water surface**.
3. The detention pond water surface at the pond outlet invert elevation shall be setback 100 feet from **proposed or existing septic system drainfields**. This setback may be reduced with written approval of the Seattle-King County Department of Public Health.

Seeps and Springs

Intermittent seeps along cut slopes are typically fed by a shallow groundwater source (interflow) flowing along a relatively impermeable soil stratum. These flows are storm driven and should discontinue after a few weeks of dry weather. The KCRTS model accounts for this shallow groundwater component, and no

special provisions are needed when directing these flows through the flow control facility. However, more continuous seeps and springs, which extend through longer dry periods, are likely from a deeper groundwater source. When continuous flows are intercepted and directed through flow control facilities, adjustments to the approved facility design may be required to account for the additional base flow (unless already considered in design). If uncertain at the time of construction, the situation may be monitored while the facility is under maintenance and defect financial guarantee. Adjustments to the facility may be required prior to the release of the financial guarantee.

Planting Requirements

Exposed earth on the pond bottom and interior side slopes shall be sodded or seeded with an appropriate seed mixture. All remaining areas of the tract must either be planted with grass, or be landscaped in accordance with the standards below and mulched with a 4-inch cover of hog fuel or shredded wood mulch.[7]

Landscaping

Landscaping for aesthetic purposes is encouraged, but not required, for most stormwater tract areas containing ponds maintained by King County (see below for areas not to be landscaped). However, if provided, landscaping must adhere to the criteria that follow so as not to hinder maintenance operations. Landscaped stormwater tracts may, in some instances, be used to satisfy requirements for recreational space. In other instances, "naturalistic" stormwater facilities may be placed in open space tracts. For more information, see page 5-25.

If landscaping is proposed in the stormwater tract of a County-maintained pond, the following requirements shall apply:

1. **No trees or shrubs may be planted within 10 feet of inlet or outlet pipes** or manmade drainage structures such as catch basins, spillways or flow spreaders. Species with roots that seek water, such as willow or poplar, should be avoided within 50 feet of pipes or manmade structures.
2. **Planting is restricted on berms that impound water** either permanently or temporarily during storms. *Note: This restriction does not apply to cut slopes that form pond banks, only to berms.*

    a) Trees or shrubs may not be planted on portions of water-impounding berms taller than four feet high. Only grasses may be planted on berms taller than four feet.

    Intent: Grasses allow unobstructed visibility of berm slopes for detecting potential dam safety problems such as animal burrows, slumping, or fractures in the berm.

    b) Trees planted on portions of water-impounding berms less than 4 feet high must be small, not higher than 20 feet mature height, and have a fibrous root system. Table 5.3.1.A gives some examples of trees with these characteristics.

    Intent: These trees reduce the likelihood of blow-down trees, or the possibility of channeling or piping of water through the root system, which may contribute to dam failure on berms that retain water.
3. All landscape material, including grass, must be **planted in good topsoil**. Native underlying soils may be made suitable for planting if amended with 2 inches of well-rotted compost tilled into the top six inches of soil. Compost used should meet Ecology publication 94-38 specifications for Grade A compost quality.
4. Soil in which **trees or shrubs** are planted may require additional enrichment or additional compost top-dressing. Consult a nurseryman, landscape professional, or arborist for site-specific recommendations.

[7] Shredded wood mulch is made from shredded tree trimmings, usually from trees cleared onsite. It must be free of garbage and weeds and may not contain excessive resin, tannin, or other material detrimental to plant growth.

5. For a naturalistic effect as well as ease of maintenance, trees or shrubs must be **planted in clumps** to form "*landscape islands*" rather than evenly spaced.
6. The **landscaped islands** must be planted above the 100-year water surface and must be a minimum of six feet apart, and if set back from fences or other barriers, the setback distance must also be a minimum of six feet. Where tree foliage extends low to the ground, the six feet of setback should be counted from the outer drip line of the trees (estimated at maturity).

   Intent: This landscape design must allow a 6-foot wide mower to pass around and between clumps.
7. Evergreen trees and trees that produce relatively little leaf-fall such as Oregon ash, mimosa, or locust are preferred. Large-leaf deciduous trees may not be planted where branches could extend over interior pond slopes.
8. All trees shall be set back so branches do not extend over the 100-year water surface of the pond to prevent leaf-drop into the water.
9. Drought tolerant species are recommended.
10. Landscape areas within the tracts of County-maintained ponds in residential subdivision developments shall be designated "to be maintained by the homeowner's association."

TABLE 5.3.1.A SMALL TREES AND SHRUBS WITH FIBROUS ROOTS

Small Trees / High Shrubs	Low Shrubs
*Red twig dogwood (*Cornus stolonifera*)	*Snowberry (*Symphoricarpus albus*)
*Serviceberry (*Amelanchier alnifolia*)	*Salmonberry (*Rubus spectabilis*)
Strawberry tree (*Arbutus unedo*)	*Rosa rugosa* (avoid spreading varieties)
Highbush cranberry (*Vaccinium opulus*)	Rock rose (*Cistus* spp.)
Blueberry (*Vaccinium* spp.)	Ceanothus spp. (choose hardier varieties)
*Filbert (*Corylus cornuta*, others)	New Zealand flax (*Phormium penax*)
Fruit trees on dwarf rootstock	
Rhododendron (native and ornamental varieties)	Ornamental grasses (e.g., *Miscanthis*, *Pennisetum)*

* *Native species*

Guidelines for Naturalistic Planting

Stormwater facilities may sometimes be located within open space tracts if "natural appearing" (see page 5-25 for details). Two generic kinds of naturalistic planting are outlined below, but other options are also possible. A booklet discussing stormwater ponds and landscaping possibilities is available at the Water and Land Resources Division; when completed, it should be consulted for additional ideas. Native vegetation is preferred in naturalistic plantings.

Note: These landscaping criteria must be followed unless a landscape professional judges that long-term quality of the open space would be improved by deviating from the criteria, AND that if the facility is maintained by the County, maintenance would not be made more difficult by the deviations.

Open Woodland

In addition to the general landscaping criteria above, the following requirements must be met:

1. Landscaped islands (when mature) should cover a minimum of 30% or more of the tract, exclusive of the pond area.
2. Tree clumps should be underplanted with shade-tolerant shrubs and groundcover plants. The goal is to provide a dense understory that need not be weeded or mowed.
3. Landscaped islands should be placed at several elevations rather than "ring" the pond, and the size of clumps should vary from small to large to create variety.
4. Not all islands need have trees. Shrub or groundcover clumps are acceptable, but lack of shade should be considered in selecting vegetation.

Note: Landscaped islands are best combined with the use of hog fuel or shredded wood mulch for erosion control (only for slopes above the flow control water surface). It is often difficult to sustain a low-maintenance understory if the area was previously hydroseeded.

Northwest Savannah or Meadow

In addition to the general landscape criteria above, the following requirements must be met:

1. Landscape islands (when mature) should cover 10% or more of the tract, exclusive of the pond area.
2. Planting groundcovers and understory shrubs is encouraged to eliminate the need for mowing under the trees when they are young.
3. Landscape islands should be placed at several elevations rather than "ring" the pond.
4. The remaining tract area should be planted with an appropriate grass seed mix, which may include northwest meadow or wildflower species. Native or dwarf grass mixes are preferred. Table 5.3.1.B below gives one acceptable dwarf grass mix. Grass seed should be applied at 2.5 to 3 pounds per 1000 square feet. *Note: Amended soil or good topsoil is required for all plantings.*
5. Creation of areas of emergent vegetation in shallow areas of the pond is recommended. Native wetland plants, such as sedges (*Carex* sp.), bulrush (*Scirpus* sp.), water plantain (*Alisma* sp.), and burreed (*Sparganium sp.*) are recommended. If the pond does not hold standing water, a clump of wet-tolerant, non-invasive shrubs, such as salmonberry or snowberry, is recommended below the detention design water surface.

Note: This landscape style is best combined with the use of grass or sod for site stabilization and erosion control.

TABLE 5.3.1.B STORMWATER TRACT "LOW-GROW" SEED MIX

Seed Name	Percentage of Mix
Dwarf tall fescue	40%
Dwarf perennial rye "Barclay" *	30%
Red fescue	25%
Colonial bentgrass	5%

* If wildflowers are used and sowing is done before Labor Day, the amount of dwarf perennial rye may be reduced proportionately to the amount of wildflower seed used.

Detention Ponds in Recreational Tracts

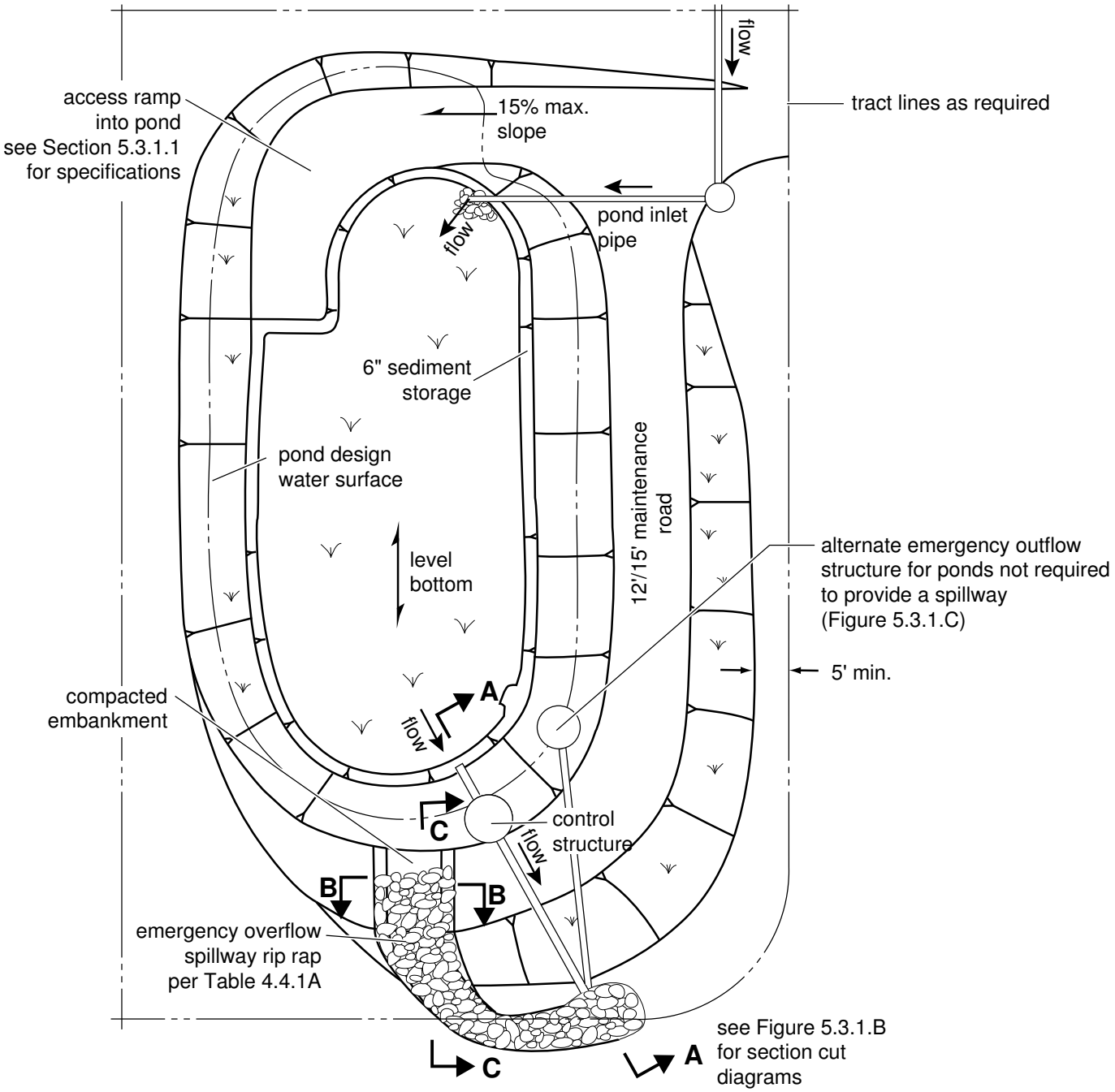
Projects required to provide onsite recreational space per KCC 21A.14.180 may combine the detention pond tract with the recreation space tract to receive a 50% reduction in required onsite recreational space. To receive the 50% credit, the following criteria must be met as required by KCC 21A.14.180.D:

1. The proposed stormwater tract must be dedicated or reserved as a part of a recreational space tract.
2. The stormwater pond must be constructed to meet the following requirements:
    a) Side slopes shall not exceed 33 percent unless they are existing, natural, and covered with vegetation.
    b) A bypass system or an emergency overflow pathway shall be designed to handle flow exceeding the facility design and located so that it does not pass through active recreation areas or present a safety hazard.
    c) The stormwater pond shall be landscaped in a manner to enhance passive recreational opportunities such as trails and aesthetic viewing.
    d) The stormwater pond shall be designed so that it does not require fencing per the fencing requirements on page 5-20.
3. Where a tract is jointly used for recreational space and King County maintained drainage facilities, the County is only responsible for maintenance of the drainage facilities, and an access easement shall be provided for that purpose.

Detention Ponds in Open Space

Open space areas reserved through the **four-to-one program** may be used to site "natural appearing" stormwater facilities if they are found to be compatible with the open space value and functions, and if they are located on a "small portion of the open space" (Amended policy I-204, King County Comprehensive Plan). Conscientious application of the "Guidelines for Naturalistic Plantings" (p. 5-23) typically will produce natural-appearing stormwater facilities. A site-specific assessment is needed, however, to determine whether the stormwater tract would be compatible with the open space value and functions.

FIGURE 5.3.1.A TYPICAL DETENTION POND



NOTE:
This detail is a schematic representation only. Actual configuation will vary depending on specific site constraints and applicable design criteria.

5.3.2 DETENTION TANKS

Detention tanks are underground storage facilities typically constructed with large diameter corrugated metal pipe. Standard detention tank details are shown in Figure 5.3.2.A (p. 5-33) and Figure 5.3.2.B (p. 5-34). Control structure details are shown in Section 5.3.4 beginning on page 5-38.

5.3.2.1 DESIGN CRITERIA

General

1. Tanks shall be designed as **flow-through systems with manholes in line** (see Figure 5.3.2.A, p. 5-33) to promote sediment removal and facilitate maintenance.

   Exception: Tanks may be designed as **back-up systems** if preceded by water quality facilities since little sediment should reach the inlet/control structure and low head losses can be expected because of the proximity of the inlet/control structure to the tank.

2. The detention tank bottom shall be located 0.5 feet below the inlet and outlet to provide dead storage for sediment.

3. The **minimum pipe diameter** allowed for a detention tank is 36 inches.

4. Tanks larger than 36 inches may be connected to each adjoining structure with a short section (2-foot maximum length) of 36-inch minimum diameter pipe.

5. Outflow **control structures** shall be as detailed in Section 5.3.4 (p. 5-38). *Note: Control and access manholes shall have additional ladder rungs to allow ready access to all tank access pipes when the catch basin sump is filled with water (see Figure 5.3.4.A, plan view, p. 5-40).*

Materials

Pipe material, joints, and protective treatment for tanks shall be in accordance with Sections 7.04 and 9.05 of the *WSDOT/APWA Standard Specification* as modified by the *King County Road Standards* and AASHTO designations. Such materials include the following:

- Lined corrugated polyethylene pipe (LCPE)
- Aluminized Type 2 corrugated steel pipe and pipe arch (meets AASHTO designations M274 and M36)
- Corrugated or spiral rib aluminum pipe and pipe arch
- Reinforced concrete pipe
- Narrow concrete vaults (see Section 5.3.3, p. 5-35).
- Corrugated steel pipe and pipe arch, Aluminized or Galvanized[8] with treatments 1 through 6
- Spiral rib steel pipe, Aluminized or Galvanized with treatments 1 through 6
- Structural plate pipe and pipe arch, Aluminized or Galvanized with treatments 1 through 6

Structural Stability

Tanks shall meet structural requirements for overburden support and traffic loading if appropriate. H-20 live loads must be accommodated for tanks lying under parking areas and access roads. The *King County Roads Standards* may have different live load requirements for structures located under roadways. Metal

[8] Galvanized metals leach zinc into the environment, especially in standing water situations. High zinc concentrations, sometimes in the range that can be toxic to aquatic life, have been observed in the region. Therefore, use of galvanized materials should be avoided. Where other metals, such as aluminum or stainless steel, or plastics are available, they shall be used. If these materials are not available, asphalt coated galvanized materials may then be used.

tank end plates must be designed for structural stability at maximum hydrostatic loading conditions. Flat end plates generally require thicker gage material than the pipe and/or require reinforcing ribs.

Tanks shall be placed on stable, well consolidated native material with a suitable bedding. Backfill shall be placed and compacted in accordance with the pipe specifications in Chapter 4. Tanks made of LCPE require inspection for deformation prior to installation as well as continuous inspection of backfilling to one foot above the top of the tank. Tanks shall not be allowed in fill slopes, unless analyzed in a geotechnical report for stability and constructability.

Buoyancy

In moderately pervious soils where seasonal groundwater may induce flotation, buoyancy tendencies must be balanced either by ballasting with backfill or concrete backfill, providing concrete anchors, increasing the total weight, or providing subsurface drains to permanently lower the groundwater table. Calculations must be submitted that demonstrate stability.

Access Requirements

1. The **maximum depth** from finished grade to tank invert shall be 20 feet.
2. **Access openings** shall be positioned a maximum of 50 feet from any location within the tank.
3. All tank access openings shall have round, solid **locking lids** with $^{5}/_{8}$-inch diameter Allen head cap screws (see *KCRS* Drawing No. 2-022 and 2-023).
4. Thirty-six-inch minimum diameter **CMP riser-type manholes** (Figure 5.3.2.B, p. 5-34) of the same gage as the tank material may be used for access along the length of the tank and at the upstream terminus of the tank if a backup system. The top slab is separated (1-inch minimum gap) from the top of the riser to allow for deflections from vehicle loadings without damaging the riser tank.
5. All tank access openings must be readily **accessible by maintenance vehicles**.

Access Roads

Access roads are required to all detention tank control structures and risers. The access roads shall be designed and constructed **as specified for detention ponds** in Section 5.3.1 (p. 5-20).

Right-of-Way

Detention tanks to be maintained by King County but not located in King County right-of-way shall be in a tract dedicated to King County. Any tract not abutting public right-of-way will require a 15-foot wide extension of the tract to accommodate an access road to the facility.

Setbacks

Setbacks (easement/tract width) and building setback lines (BSBLs) for tanks shall be the same as for pipes (see Section 4.1).

5.3.2.2 METHODS OF ANALYSIS

Detention Volume and Outflow

The volume and outflow design for **detention tanks** shall be in accordance with the performance requirements in Chapter 1 and the hydrologic analysis and design methods in Chapter 3. Restrictor and orifice design shall be according to Section 5.3.4 (p. 5-38).

5.3.3 DETENTION VAULTS

Detention vaults are box-shaped underground storage facilities typically constructed with reinforced concrete. A standard detention vault detail is shown in Figure 5.3.3.A (p. 5-37). Control structure details are shown in Section 5.3.4 beginning on page 5-38.

5.3.3.1 DESIGN CRITERIA

General

1. Detention vaults shall be designed as **flow-through systems** with bottoms level (longitudinally) or sloped toward the inlet to facilitate sediment removal. Distance between the inlet and outlet shall be maximized (as feasible).
2. The detention **vault bottom** shall slope at least 5% from each side towards the center, forming a broad "v" to facilitate sediment removal. *Note: More than one "v" may be used to minimize vault depth.*

   Exception: The vault bottom may be flat if **removable panels** are provided over the entire vault. Removable panels shall be at grade, have stainless steel lifting eyes, and weigh no more than 5 tons per panel.
3. The **invert elevation of the outlet** shall be elevated above the bottom of the vault to provide an average 6 inches of sediment storage over the entire bottom. The outlet must also be elevated a minimum of 2 feet above the orifice to retain oil within the vault.
4. The outflow system and restrictor device shall be designed according to the applicable requirements specified for **control structures** in Section 5.3.4 (p. 5-38).

Materials

Minimum 3,000 psi structural reinforced concrete must be used for all detention vaults. All construction joints must be provided with water stops.

Structural Stability

All vaults shall meet structural requirements for overburden support and H-20 traffic loading. Vaults located under roadways must meet the live load requirements of the *King County Road Standards*. Cast-in-place wall sections shall be designed as retaining walls. Structural designs for vaults must be stamped by a licensed structural engineer unless otherwise approved by DDES. Vaults shall be placed on stable, well-consolidated native material with suitable bedding. Vaults shall not be allowed in fill slopes, unless analyzed in a geotechnical report for stability and constructability.

Access Requirements

1. **Access** consisting of a frame, grate and locking cover shall be provided over the inlet pipe and outlet structure. Access openings shall be positioned a maximum of 50 feet from any location within the vault; additional access points may be required on large vaults. If more than one "v" is provided in the vault floor, access to each "v" must be provided.
2. For vaults with **greater than 1250 square feet of floor area**, a 5' by 10' removable, locking panel shall be provided. Alternatively, a separate access vault may be provided as shown in Figure 5.3.3.A (p. 5-37).
3. For **vaults under roadways**, the removable panel must be located outside the travel lanes. Alternatively, multiple standard locking manhole covers (see KCRS Drawing No. 2-022 and 2-023) may be provided. Spacing of manhole covers shall be 12 feet, measured on center, to facilitate removal of sediment. Ladders and hand-holds need only be provided at the outlet pipe and inlet pipe,

and as needed to meet OSHA confined space requirements. Vaults providing manhole access at 12-foot spacing need not provide corner ventilation pipes as specified in Item 10 below.

4. All **access openings**, except those covered by removable panels, shall have round, solid **locking covers** (see *KCRS* Drawing Nos. 2-022 and 2-023), or 3-foot square, locking diamond plate covers. For raised openings where the depth from the iron cover to the top of the vault exceeds 24 inches, an access structure equivalent to a Type 2 catch basin or Type 1 manhole shall be used (see KCRS Drawing Nos. 2-005 and 2-007). The opening in the vault lid need not exceed 24 inches in diameter.
5. Vaults with widths 10 feet or less must have **removable lids**.
6. The **maximum depth** from finished grade to the vault invert shall be 20 feet.
7. **Internal structural walls** of large vaults shall be provided with openings sufficient for maintenance access between cells. The openings shall be sized and situated to allow access to the maintenance "v" in the vault floor.
8. The **minimum internal height** shall be 7 feet from the highest point of the vault floor (not sump), and the **minimum width** shall be 4 feet.

   Exceptions:

   - Concrete vaults may be a minimum 3 feet in height and width **if used as tanks** with access manholes at each end, and if the width is no larger than the height.
   - The minimum internal height requirement may be waived for any areas covered by removable panels.
9. **Ventilation pipes** (minimum 12-inch diameter or equivalent) shall be provided in all four corners of vaults to allow for artificial ventilation prior to entry of maintenance personnel into the vault.

Access Roads

Access roads are required to the access panel (if applicable), the control structure, and at least one access point per cell, and they shall be designed and constructed **as specified for detention ponds** in Section 5.3.1 (p. 5-20).

Right-of-Way

Detention vaults to be maintained by King County but not located in King County right-of-way shall be in a tract dedicated to King County. Any tract not abutting public right-of-way will require a 15-foot wide extension of the tract to accommodate an access road to the vault.

Setbacks

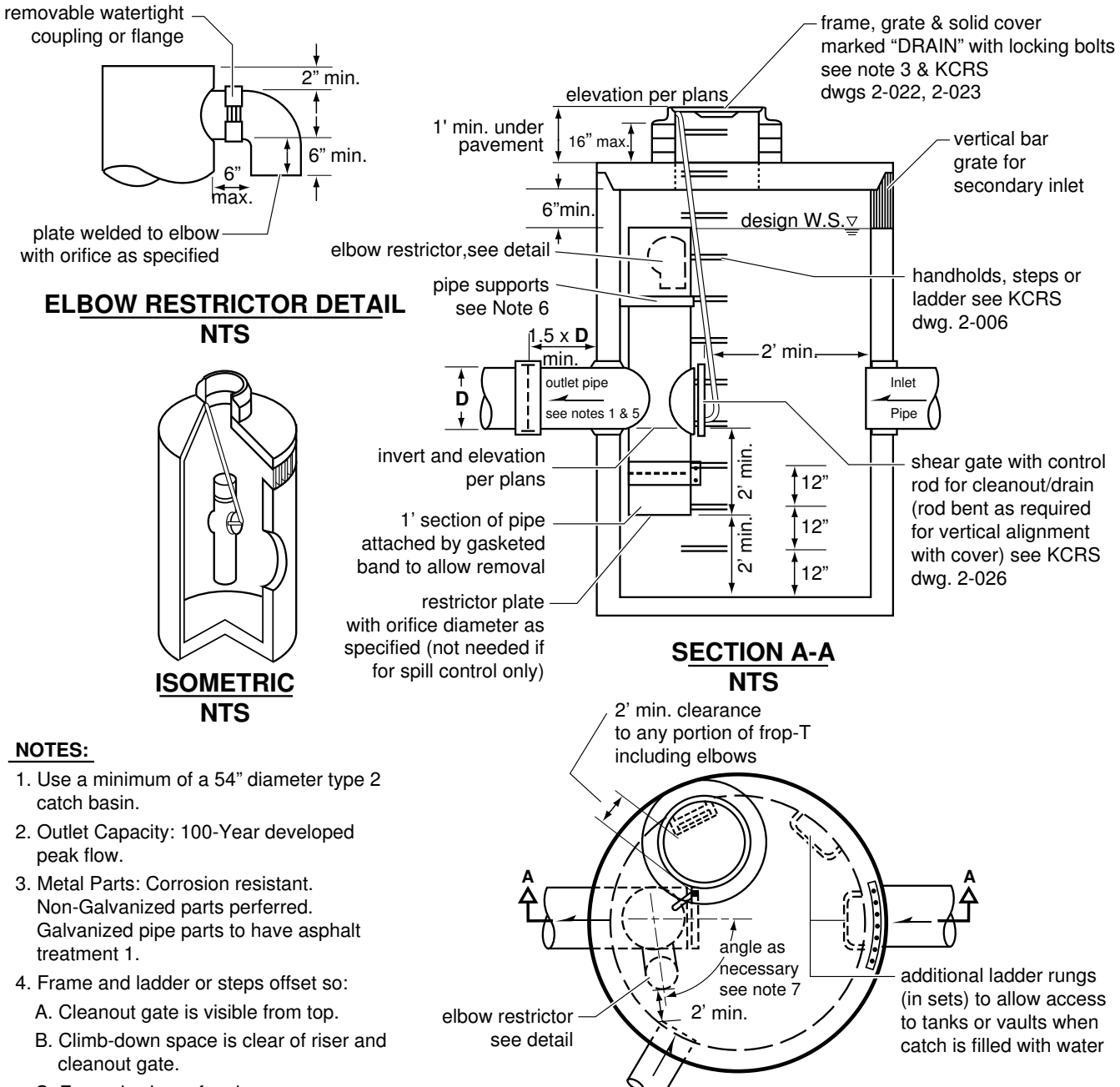
Setbacks to tract/easement lines for vaults shall be 5 feet; adjacent building setback lines shall be 10 feet. For privately owned and maintained vaults, building foundations may serve as one or more of the vault walls.

5.3.3.2 METHODS OF ANALYSIS

Detention Volume and Outflow

The volume and outflow design for detention vaults shall be in accordance with the performance requirements in Chapter 1 and the hydrologic analysis and routing/design methods in Chapter 3. Restrictor and orifice design shall be according to Section 5.3.4 (p. 5-38).

FIGURE 5.3.4.A FLOW RESTRICTOR (TEE)



NOTES:

1. Use a minimum of a 54" diameter type 2 catch basin.
2. Outlet Capacity: 100-Year developed peak flow.
3. Metal Parts: Corrosion resistant. Non-Galvanized parts perferred. Galvanized pipe parts to have asphalt treatment 1.
4. Frame and ladder or steps offset so:
   A. Cleanout gate is visible from top.
   B. Climb-down space is clear of riser and cleanout gate.
   C. Frame is clear of curb.
5. If metal outlet pipe connects to cement concrete pipe: outlet pipe to have smooth O.D. equal to concrete pipe I.D. less 1/4".
6. Provide at least one 3" X .090 gage support bracket anchored to concrete wall. (maximum 3'-0" vertical spacing)
7. Locate elbow restrictor(s) as necessary to provide minimum clearance as shown.
8. Locate additional ladder rungs in structures used as access to tanks or vaults to allow access when catch basin is filled with water.